

2/PRTS

09/462224

PCT/NL98/00368

514 Rec'd PCT/PTO 03 JAN 2000

1

RAIL TRACK HAVING ENHANCED ABSORPTION OF VIBRATION AND
SOUNDBACKGROUND OF THE INVENTION

a The present invention relates to a rail track comprising at least two parallel rails supported by a non-compressible base body.

5 In many rail tracks the rails are connected with sleepers which lie on a base body, for instance gravel. An alternative is to mount the rails on a concrete slab or on a steel bridge.

10 Through rolling of the wheels of the train over the rails and as a result of the unevenness occurring on the wheels and rails, the wheels and the rails will be set into vibration. The vibrations in the rails become weaker as the distance relative to the contact point between wheel and the rail becomes larger. The reason that these vibrations become weaker is partly the result of dissipation in the rail but is caused to a much greater extent
15 because the energy from the rail related to the vibrations is discharged to the base body via the rail support. A part of this discharged energy will be dissipated in the rail supports themselves and a part of this energy
20 will be dissipated in the base body.

A resilient element is generally arranged between the rails and the sleepers, the concrete slab or the steel bridge. This is done to reduce the exchange of forces from the rail to the base body, whereby the life-
25 span of the rail and the base body is prolonged. For this purpose the railway companies for instance apply the regulation that the rails must undergo a displacement of 1.5 to 2.5 mm at an axle load of 22.5 tons.

In addition, the transfer of vibrations to the base
30 body is reduced by this resilient rail support. The resilient element insulates the vibrations, which results in a reduction of the vibration level of the base body and to a reduction in the sound radiation from the base body. The result of a better vibration insulation is that

09/462224-010000

regulation that the rails must undergo a displacement of 1.5 to 2.5 mm at an axle load of 22.5 tons.

In addition, the transfer of vibrations to the base body is reduced by this resilient rail support. The resilient element insulates the vibrations, which results in a reduction of the vibration level of the base body and to a reduction in the sound radiation from the base body. The result of a better vibration insulation is that the rail will begin to vibrate more strongly and therefore becomes a more significant source of noise.

Another sound-damping system for rail tracks known from WO-A-9110778 is casting flexible material in the rail. This system has the drawback that the rail begins to radiate sound more efficiently because the casting mass acts as reflector for the sound radiated by the rail and because the casting mass begins to function as an extra source of noise. In addition, use is made herein of a large volume of expensive polymer material to fix the rail.

On the basis of the foregoing, it can be concluded that acoustic measures will have to be taken in a balanced manner in order to reduce the total noise level of all sources together and to obtain an improved vibration damping of the rail track.

SUMMARY OF THE INVENTION

The object of the present invention is to achieve a reduction in the noise production of rail tracks while still complying with the regulation of the railway companies. For this purpose a rail track is provided wherein the surface between the running surface and the bearing surface of the rail is covered with a second layer of yielding material.

Since only the running surface of the head of the rail lies free, the sound-radiating surface of the rail is reduced. The layer also radiates a minimum of noise because the surface making contact with the air is minimal. In addition, energy is better dissipated by the

5

THE GEF

minimal volume of expensive polymer material is required to embed the rail in the base body.

When a rail is used with a non-releasing form, such as the I-shaped rail known from the prior art, it is advantageous for arrangement of the rail in the base body to provide herein a rectangular channel-like recess, whereafter the space between the second layer and the channel-like recess is filled with a filler body of non-compressible material. In this manner the thin layer remains coupled to the non-compressible base body in improved manner and the above stated advantages are preserved.

The second layer preferably has a greater stiffness than the first layer. The stiffness of both layers is preferably as high as possible so that maximum dissipation can be obtained. The stiffness in vertical direction is however bounded by the regulation of the railway companies relating to the displacement under load of the rail vehicle. The material of the yielding layers must therefore be chosen such that the static/quasi-static requirement can be satisfied while at the same time the greatest possible acoustic stiffness is provided. For the horizontal direction the stiffness of the second layer may only be bounded by the fact that this layer must still be able to shear sufficiently to allow the vertical displacement.

The second layer preferably has on the one side of the rail a different stiffness than on the other side. A coupling is hereby obtained between vertical and horizontal vibrations, which is more advantageous for the damping of formerly substantially vertical rail vibrations, so that an even better vibration damping is provided.

Another possibility of obtaining a coupling between vertical and horizontal vibrations is to make use of a rail with an asymmetrical cross-section.

For determined forms of rail it can be advantageous to embody the first and/or second layer of yielding material in interrupted manner so as to be able to comply with the regulations of the railway companies and also to

be able to obtain an improved vibration damping and sound reduction.

It has already been noted above that the advantage of embedding the rail with a yielding layer in a non-compressible base body is that the sound-radiating surface of the rail is hereby reduced. However, the base body now acts as reflector for the sound which is radiated by the head of the rail. The upper side of the base body can therefore be provided with a layer of sound-absorbing material.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be further elucidated with reference to the annexed drawing. In the drawing:

fig. 1 shows a partial cross-section of a first embodiment of the rail track according to the present invention;

fig. 2 shows a partial cross-section of a second embodiment of the rail track according to the present invention;

fig. 3 shows a partial cross-section of a third embodiment of the rail track according to the present invention;

fig. 4 shows a partial cross-section of a fourth embodiment of the rail track according to the present invention;

fig. 5 shows a partial cross-section of a fifth embodiment of the rail track according to the present invention, and

fig. 6 shows a partly perspective view of the rail track according to the embodiment of fig. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Corresponding components are designated in the drawing with the same reference numeral. A rail 2 is supported in a non-compressible base body 1, for instance of concrete. In order to support rail 2 a channel-like recess 3 is provided in base body 1. Rail 2 has a head 4 having on the top part thereof a running surface 5 for a wheel 6 of a rail vehicle (see fig. 1 and 5). A first layer of yielding material 9 is provided between the foot 7 of rail 2 and the bottom 8 of channel-like recess 3. The surface between running surface 5 and the foot 7 of the rail is covered with a second layer of yielding

material 10. The top side of base body 1 is provided with a layer of sound-absorbing material 11.

The first embodiment of fig. 1 shows a rectangular rail 2 with a curved running surface 5 on which wheel 6 of a rail vehicle supports. With the exception of running surface 5, the periphery of rail 2 is covered with a thin layer of yielding material 9, 10, wherein the second layer on the inside and outside of the rail has a greater stiffness than the first layer on the underside of rail 2. The stiffness of the first layer is bounded by railway company regulations relating to the displacement under load of the rail vehicle, for instance 1.5 to 2.5 mm at an axle load of 22.5 ton. The stiffness of the second layer 10 is only bounded by the fact that the material must still be able to shear sufficiently to allow vertical displacement. In addition, the material of the first yielding layer 9 and the second yielding layer 10 is chosen such that the highest possible acoustic stiffness is obtained in both horizontal and vertical directions. The open surface of the layer on the top side of the base body is minimal, whereby the layer radiates a minimum of noise. In addition, the layer dissipates vibrations better owing to the chosen material properties thereof, because the layer is coupled to a high-impedance base body and because the rail is completely enclosed, whereby horizontal vibrations are effectively damped.

Fig. 2 shows a second embodiment of the present invention, wherein a rail 2 known from the prior art is received in a rectangular channel-like recess 3. Once rail 2 with its covering has been arranged in channel-like recess 3 the space between second layer 10 and channel-like recess 3 is filled with a filler body 12 of non-compressible material. This can be the same material as that of base body 1 but has in any case a greater stiffness than second layer 10. According to the present invention one of both or both layers can take an interrupted form. In the embodiment of fig. 2 this is the case for first layer 9.

In a third embodiment of the present invention in fig. 3, use is made of another rail 2 which is more

flexible, i.e. has a lower moment of inertia, than the rail 2 of fig. 2 known from the prior art. Because a more flexible rail 2 is used, the first and second layer 9, 10 and base body 1 can be given a stiffer form, which results in an even better vibration damping.

The fourth embodiment of the present invention of fig. 4 shows, as does the third embodiment, a rail 2 with an asymmetrical form. Owing to the asymmetrical form of rail 2 a coupling is obtained between the vertical and horizontal vibrations, which is once again more favourable for the damping of vibrations. The advantage of the rail 2 used in the fourth embodiment is that it has a releasing form.

The fifth embodiment of fig. 5 shows a rail known from the prior art wherein the web recess of the rail is filled with extra mass 13. In this case the rail is formed by the I-profile and the mass. The rail is again covered with a layer of yielding material 9,10 and supported in a channel-like recess 3, wherein the space between second layer 10 and channel-like recess 3 is filled with a filler body 12.

Fig. 6 shows a partly perspective view of the rail track according to the present invention in accordance with the first embodiment of fig. 1.

The stiffness of the layers of yielding material can vary along the periphery of the rail if this is required in order to comply with railway company regulations and also to obtain an improved vibration damping and noise reduction.

It is also possible to line the bottom of the channel-like recess with one or other material before arranging the rail with its covering. This may for instance be necessary from a structural point of view or be required by the railway companies. In this case the bottom of the channel-like recess is formed by the top side of this lining.

A rail track according to the present invention is expected to achieve a noise reduction in the order of 5 decibels (A) on the rail noise relative to a normal rail track.